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EFFECTS OF PERFORMANCE-ORIENTED TEXT UPON LONG-TERM RETENTION OF FACTUAL MATERIAL

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Little information exists on variables affecting long-term retention of factual material in technical training. Two experiments compared a job-oriented text with a topic-oriented text. Twenty-four junior college students studied individualized booklets to learn factual material, on either metal fasteners or micrometers, to criterion. Six months later, an unanticipated retention test was given. On the test on metal fasteners, students who had received job-oriented text had significantly better retention on recall, but there were no differences on a recognition test. There were no differences for the

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text on micrometers. The results are discussed in terms of the role of supplementary related material on retention of factual material.

FOREWORD

This research was performed as a technical directive on contract N-123-80-C-30339 in support of the Skill and Knowledge Retention project ZF63-522-010-03.07). The main objective of this project is to develop techniques that can be used by Navy planners to design training and job conditions that will help personnel maintain job skills and minimize performance deterioration due to forgetting.

The results of this work are intended for incorporation in the instructional systems development procedures used by the Chief of Naval Education and Training, the Chief of Naval Technical Training, and the Commanders, Pacific and Atlantic Training Commands.

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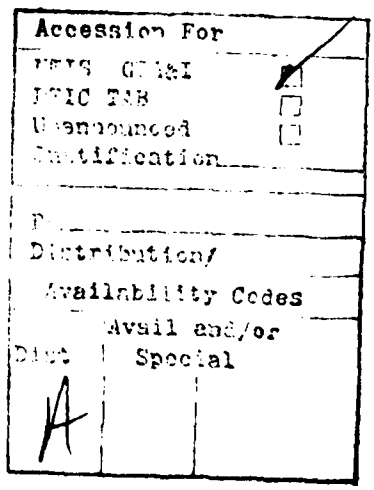

SUMMARY

Problem

A recurring problem in training is that students forget much of what they have been taught by the time they get to the job. It is important, therefore, to obtain data on instructional variables that can enhance long-term retention of technical materials.

Purpose

The purpose of this research was to compare the effects on long-term retention of material presented in two different types of text. The first type of presentation uses performance- or job-oriented texts in which information is given in the context of a job to be performed. The second type uses topic-oriented texts in which the information is presented without a specific context.

Approach

Two experiments were conducted. Both compared the effects of job- versus topic-oriented text on long-term retention. Fifty-six junior college students enrolled in a Basic Mechanics Course participated in the studies. Students were given either job- or topic-oriented texts which they learned to criterion (90 percent). Twenty-seven of the original 56 students were tested for long-term retention approximately 6 months later.

Findings

The results of Experiment 1 showed that the use of a job-oriented text improved long-term retention of material about metal fasteners. There were no differences between groups in Experiment 2, which dealt with micrometers instead of fasteners. This was probably because it was more difficult to develop two distinctly different texts for micrometers than it was for metal fasteners.

Conclusions

Placing technical material in a job context can improve long-term retention. It is hypothesized that job-oriented materials facilitate retention by presenting new information in the context of what students already know.

Recommendations

1. The results of Experiment 1 show that a job-oriented context can be effective in some situations. However, because no effect was found in Experiment 2, further research is needed to define the conditions under which job-oriented contexts are beneficial.

2. Navy instructional designers and developers should attempt to provide job- or performance-oriented contexts for students learning factual material.

3. Research and development should continue in this area to determine the applicability of the findings to other types of content and to further validate the long-term retention effect. Future plans include work to identify training strategies and job conditions that enhance retention of knowledges and skills.

In addition, specific prescriptions for producing job-oriented instruction need to be developed. There are some existing guidelines for doing this in Kern, Stitch, Welty, & Hauke (1976). This work should focus on developing explicit procedures for developing job-oriented instruction. Accomplishing this goal will involve a thorough analysis of how and why job-oriented contexts enhance information processing.

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INTRODUCTION

Problem

A recurring problem in training is that students forget much of what they have been taught by the time they get to the job. It is important, therefore, to obtain data on instructional variables that can enhance long-term retention of technical materials.

Purpose

The purpose of this research was to compare the effects on long-term retention of material presented in two different types of text. The first type of presentation uses performance- or job-oriented texts in which information is given in the context of a job to be performed. The second type uses topic-oriented texts in which the information is presented without a specific context.

Background

Although the goal of all training is the long-term retention of the information or skills presented to the learner, the variables affecting long-term retention have not been systematically studied.

Current theories of how people learn from text emphasize that reading is a problem-solving task (Kintsch & van Dijk, 1978). The reader searches the text to find new information that fits in with what he or she already knows. The reader then integrates the new information text with the already-known. These theories suggest that students will comprehend instructional material most easily when they have, or are given, a framework or context in which to integrate the new material. Furthermore, it is predicted that the greatest impact of using or providing a framework will be on long-term memory because elaborate knowledge structures should be more resistant to forgetting.

The findings and predictions of Kintsch & van Dijk (1978), and of other researchers in this area, have been incorporated in the Navy's Instructional Quality Inventory (IQI) (Wulfeck, Ellis, Richards, Wood, & Merrill, 1978). The IQI contains criteria for evaluating the quality of instruction. One criterion given in the IQI, adopted from Kintsch & van Dijk (1978) and from Kern, Sticht, Welty, & Hauke (1976), is that instructional materials should be performance- or job-oriented rather than topic-oriented. Specifically, the prescription is that information should be presented with direct reference to the situations in which it would be used. The prediction is that material that is meaningfully related to other knowledge will be learned and retained better than material that is organized by topic only. This prediction is consistent with Kintsch & van Dijk's (1978) findings.

APPROACH

This research tested the job-oriented prescription of the IQI. The research question was "does presenting technical information in a performance- or job-oriented context enhance long-term retention of the training material?" Two experiments compared the effects of job-oriented and topic-oriented text on long-term retention. Two sets of technical material were learned to criterion in an individualized learning format. The two sets of materials differed in their task/content classification on the Instructional Quality Inventory Task/Content Matrix (See Ellis, Wulfeck, & Fredericks, 1979, for a detailed explanation of the Task/Content Matrix). For Experiment 1, the materials were classified

as "Remember Fact." For Experiment 2, some of the materials were "remember fact" and some were "use procedure." The students participating in this research were tested for long-term retention approximately 6 months after the initial learning sessions.

EXPERIMENT 1

Method

Materials

The experimental materials consisted of two individualized instructional texts, a practice test, a criterion test, and two long-term retention tests.

Both the instructional texts dealt with metal fasteners (e.g., bolts, screws, studs, etc.). Students were required to learn several facts about fasteners (e.g., the names, functions, appearance, etc.). Naturally, all the factual information included in one version was also included in the other. One of the texts was topic-oriented and the other job-oriented.

In the job-oriented text, the metal fasteners were discussed in the context of a job-like situation. For example, the section on studs began as follows: "Your first fix-it project has you tackling the engine of an old car. You'll find studs holding the engine's head to the block."

The topic-oriented text was adopted from the text on metal fasteners used in the Navy's Basic Mechanics Course. The materials were organized by topic (e.g., type of fastener) and there were few references to job situations in which the fasteners would be used. For example, the introduction began with "The four common types of metal fasteners, bolts, screws, studs, and nuts all have one thing in common: threads."

The practice test had 28 questions and covered all the facts presented in the text passages. The criterion test had 24 questions selected from the questions on the practice test. There were two types of questions. In the first type, the student was given a verbal description of the function of a fastener and was required to recall the name. In the second type, a picture of a fastener was presented and the student, again, had to recall the name.

The long-term retention test contained the same 24 questions that were on the criterion test. However, the testing procedure was changed for half of the questions to obtain a more sensitive measure of long-term retention. The first 12 questions, test A, were identical to the criterion test questions. The 12 questions in test B were also identical to criterion test questions; however, the students were given a "parts list" that contained the names of all the types of fasteners discussed in the text. Thus, test A tested recall of fastener names, and test B tested recognition. Tests A and B each had six questions in which students had to identify the fastener from a description of its function and six questions in which they had to identify the fastener from a picture.

Subjects

Subjects were 56 students enrolled in the Basic Mechanics Course in Agriculture in Butte Junior College, Chico, California. Twenty-nine received the job-oriented materials and 27 received the topic-oriented materials.

Procedure

The initial part of the study was conducted during three weekly lectures in the fall quarter of 1979. The learning materials were presented as part of the course requirements, but were not actually part of the existing course materials. The job- and topic-oriented instructional materials were randomly distributed to the students who were instructed to (1) study the material until they thought they knew it well, (2) take the practice tests, and (3) check their answers. If they missed any of the practice questions, they were to study the material again and retake the practice test. When they had all practice items correct, they brought the booklet to the experimenter and were given the criterion test. This procedure was continued until each student received a score of at least 21 answers correct out of 24 questions. The experimenters recorded the time when each student began to study the lesson and the time when he or she completed the criterion test.

The students were contacted during the spring quarter, approximately 6 months after taking the criterion test, and offered $5.00 to come in for "follow-up" testing (they had not been told earlier that there would be any additional testing). Only 27 of the original 56 students returned for the long-term retention tests. Twelve had received the job-oriented texts and 15 had received the topic-oriented materials. After testing, the students completed a questionnaire that asked them about their experiences with fasteners in the interval since they had taken the criterion test.

Results

Data were recorded and analyzed only for those students who completed the long-term retention test. Results from the criterion test, which revealed no reliable differences between groups, were:

1. The mean number of trials to reach criterion was 1.33 for both groups.

2. The mean study time to reach criterion was 80 minutes for the job-oriented group and 58.07 minutes for the topic-oriented group ($F(1,25) = 2.6$. $p > .05$).

3. The mean score on the criterion test was 22.42 for the job-oriented group and 23.2 for the topic-oriented group.

The differences between the student's scores on long-term retention test A and on the corresponding items from the criterion test given at the end of training were computed to measure loss of information over time. The job-oriented group had a mean loss of 5.66 items, while the topic-oriented group lost 7.53 items ($F(1,25) = 5.29$, $p < .05$). Thus, the job-oriented group retained 40 percent of the material, while the topic-oriented group retained only 53 percent.

The same measure was computed for test B. On this test, the job-oriented group had a mean loss of 3.58 items while the topic-oriented group had a loss of 4.54 item ($F(1,25) = 1.21$, $p > .05$). On this measure, the job-oriented group retained 68 percent of the information and the topic-oriented group retained 61 percent. Thus, the groups differed significantly on test A but not on test B.

There were no differences in the responses to the questionnaires about their experience with fasteners in the interval between learning the material and taking the long-term retention tests.

EXPERIMENT 2

In Experiment 2, the learning material dealt with micrometers. As stated earlier, some of the information to be learned was "remember fact" and some was "use procedure." The "remember fact" text was concerned with remembering the names of the parts of a micrometer while the "use procedure" text involved learning how to read a micrometer.

Method

The method was identical to that of Experiment 1 except for the materials. Subjects completed the materials for Experiment 2 after they finished those for Experiment 1.

Materials

The experimental materials consisted of two instructional texts, a practice test, a criterion test, and two long-term retention tests.

As in Experiment 1, two texts were developed. The job-oriented text was presented in the context of a job-like situation. The topic-oriented text was adapted from the text on micrometers used in the Navy Basic Mechanics Course. However, because of the nature of micrometers, the topic-oriented materials had a very job-like quality to begin with. The differences between the two micrometer texts were not as great as the differences between the two fastener texts.

The practice test had 10 "remember fact" questions and 14 "use procedure" questions. The "use procedure" questions required the student to view pictures of micrometers set in various ways and to then determine the value of the setting.

The criterion and long-term retention tests had the same 24 items. There were two separate long-term retention tests, as in Experiment 1. Each test had five "remember fact" and seven "use procedure" items. Test B included a "parts list," which listed all the parts and types of micrometers given in the texts.

Subjects

The same students served in both experiments.

Procedure

The procedure was identical to the procedure in Experiment 1. When a student completed the learning materials and practice test, he or she was given the criterion test. Approximately 6 months after the criterion test was taken, the long term retention tests were given to nine students that had received job-oriented texts and to 15 students that had received the topic-oriented texts. The retention tests for Experiment 2 were taken after the retention tests for Experiment 1 had been completed.

Results

Data were recorded and analyzed only for those students who completed the long-term retention test. The analyses were the same as in Experiment 1. The results for initial learning and criterion test performance were:

1. The mean number of trials to reach criterion was 1.11 for the job-oriented group and 1.07 for the topic-oriented group.

2. The mean study time was 39.78 minutes for the job-oriented group and 28.13 minutes for the topic-oriented group ($F(1,22) = 2.66$, $p > .05$).

3. The mean score on the criterion test was 23.22 for the job-oriented group and 23.07 for the topic-oriented group.

The two groups did not differ significantly on any of these measures.

The differences between the students' scores on test A and their scores on the same items on the criterion test were computed to determine information loss over time. The job-oriented group had a mean loss of 7.00 items while the topic-oriented group lost 6.20 items. Thus, the job-oriented group retained 41 percent of the material while the topic-oriented group retained 47 percent. The differences between the students' scores on test B and the same items on the criterion test were also calculated. Mean loss for the job-oriented group was 4.22 items while the topic-oriented group lost 4.33 items. The groups did not differ significantly on either of these measures.

The two groups did not differ in their responses to the questionnaire about their experience with micrometers during the interval between learning the material and taking the long-term retention tests.

DISCUSSION AND CONCLUSIONS

The results of Experiment 1 indicate that job-oriented text can significantly improve long-term retention of factual material. Since the effect was not obtained when students were given a "parts list," it can be concluded that job-oriented text affected recall memory rather than recognition memory. Presumably, the job-oriented text was effective in relating new knowledge to existing knowledge in a meaningful way. The results provide direct support for the IQI prescription that instruction should be performance- or job-oriented rather than topic-oriented.

It is not clear why the performance-oriented text did not improve retention for the micrometer text in Experiment 2. As stated earlier, the topic-oriented text was very job-like to begin with; thus, the two micrometer texts were not as distinctive as the two fastener texts. The procedure of using a micrometer is not dependent on a specific job situation, but rather on the type of measurement activity.

RECOMMENDATIONS

1. Since an effect was found in Experiment 1 but not in Experiment 2, further exploration of the conditions under which job-oriented materials would be beneficial is required.

2. Instructional designers and developers should attempt to provide a performance- or job-oriented context for students learning factual materials.

3. Research and development should continue in this area to determine the applicability of the findings to other types of content and to further validate the long-term retention effect. Future plans include work to identify training strategies and job conditions that enhance retention of knowledges and skills.

In addition, specific prescriptions for producing job-oriented instruction need to be developed. There are some existing guidelines for doing this in Kern et al. This work should focus on developing explicit procedures for developing job-oriented instruction. Accomplishing this will involve a thorough analysis of how and why job-oriented contexts enhance information processing.

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